Measure 1: Transit Travel Time

Monitoring Objectives

The purpose of monitoring transit travel times was to answer the following questions regarding transit travel times in the Seattle downtown core before and after tunnel closure:

- How long are the transit travel times in the Seattle downtown core?
- How consistent are the transit travel times in the Seattle downtown core?
- Where are slowdowns occurring and are there mitigation measures that might address these slowdowns?

Methodology

Transit travel times on surface streets were measured using roadside bus detection equipment at sixteen (16) locations in the Seattle downtown core. The locations of these detection points are identified in Figure 3. A description of the equipment and technology can be found in the methodology section of the Volume 1 Baseline pre-tunnel closure report.

The collection of transit travel times began in summer 2005. Transit travel times have been continuously collected throughout the tunnel closure period. Two levels of data are included in the regular performance reports issued by the Monitor and Maintain Committee:

Level 1: Seattle downtown core summary statistics are the highest level summary. They consist of aggregated travel times through the study area to define an average transit operating time in the Seattle downtown core on surface streets for the AM peak and the PM peak. This measure will show the amount of time a bus takes on average to traverse the downtown area. Considered over time, this measure will give an overall trend of the increase or decrease in delay on surface streets caused by tunnel closure.

Level 2: Transit Corridor Travel Time summary tracked travel time along a discrete set of transit corridors on surface streets in the central business district. The transit corridors included in the monitoring are identified in Figure 2. The data was categorized by corridor and by time of day (AM Peak and PM Peak). Variability of the data was also reported to show the consistency of transit travel times.

Figure 3. Transit Travel Time Summary Analysis Corridors and Detection Point Locations

Transit Travel Time Comparison

For this report, weekday travel times between October 1, 2007 and November 9, 2007 were used. This period coincided with the fall 2007 service change that went into effect Saturday, September 22nd. This period marked the reopening of the transit tunnel. In addition to many routes returning to the tunnel, several routes were moved from Second Avenue to Third Avenue as part of the implementation of the Transit Blueprint for the Seattle Central Business District (CBD). Also, since the re-opening of the tunnel, there is no longer regular service on Virginia Street that follows the routing previously measured by the downtown transit monitoring system. Consequently, no data was reported for this corridor. Finally, equipment located near Safeco Field experienced communications interference that prevented the collection of northbound First Avenue travel times. Time-of-day periods, monitoring locations and analysis tiers, as described in the previous section, are the same as the baseline report, except where noted.

Seattle Downtown Core Travel Time Summary (Level 1):

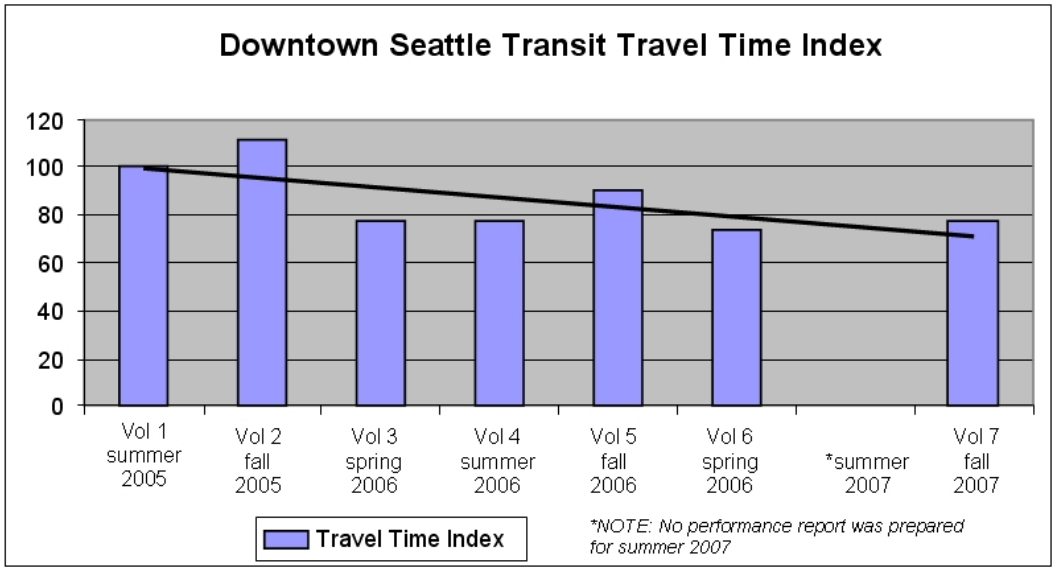
The first level of analysis for downtown transit travel time is a composite measurement of average time spent in the study area. This value is obtained by identifying the first and last observation of a bus trip in the downtown core, regardless of the corridor. Averaging this figure for all trips results in a single value of time spent in the downtown core for all observed trips.

This value is used as an index, not a measure. This figure includes layover time as well as through-routed trips under one measurement. It will also include many different paths through the downtown core with different lengths and travel conditions. The measure becomes meaningful when compared to the same measurement to compare the ease of travel for transit through the downtown core.

The baseline Travel Time Index is **100**, represents the value before tunnel closure. The average travel time value at that time was determined to be 21:59, based on bus trips between 4 - 6 PM on weekdays during the months of July and August, 2005. The data used for this report covers six weeks of the fall 2007 service change. The Travel Time index for this reporting period is **77**, based on an average travel time of 16:53. The current index represents a **23%** decrease in time spent in the downtown core over the baseline, and a **4%** increase over the previous reporting period.

A summary of the travel time indexes from baseline, through tunnel closure and concluding with tunnel reopening is provide in Figure 4.

Figure 4. Downtown Seattle Travel Time Index



Transit Corridor Travel Time Summaries (Level 2)

The four charts in Figure 5 illustrate the average travel times for transit after tunnel closure on selected corridors. The data for Volume 7 was collected in October and November of 2007 using the monitoring system. The data used is for weekdays only. Each chart shows the average travel time for the direction of travel and time of day indicated. The AM charts include buses observed between 7 – 9 AM at the first reader on the corridor being measured. The PM charts cover the time period from 4 – 6 PM.

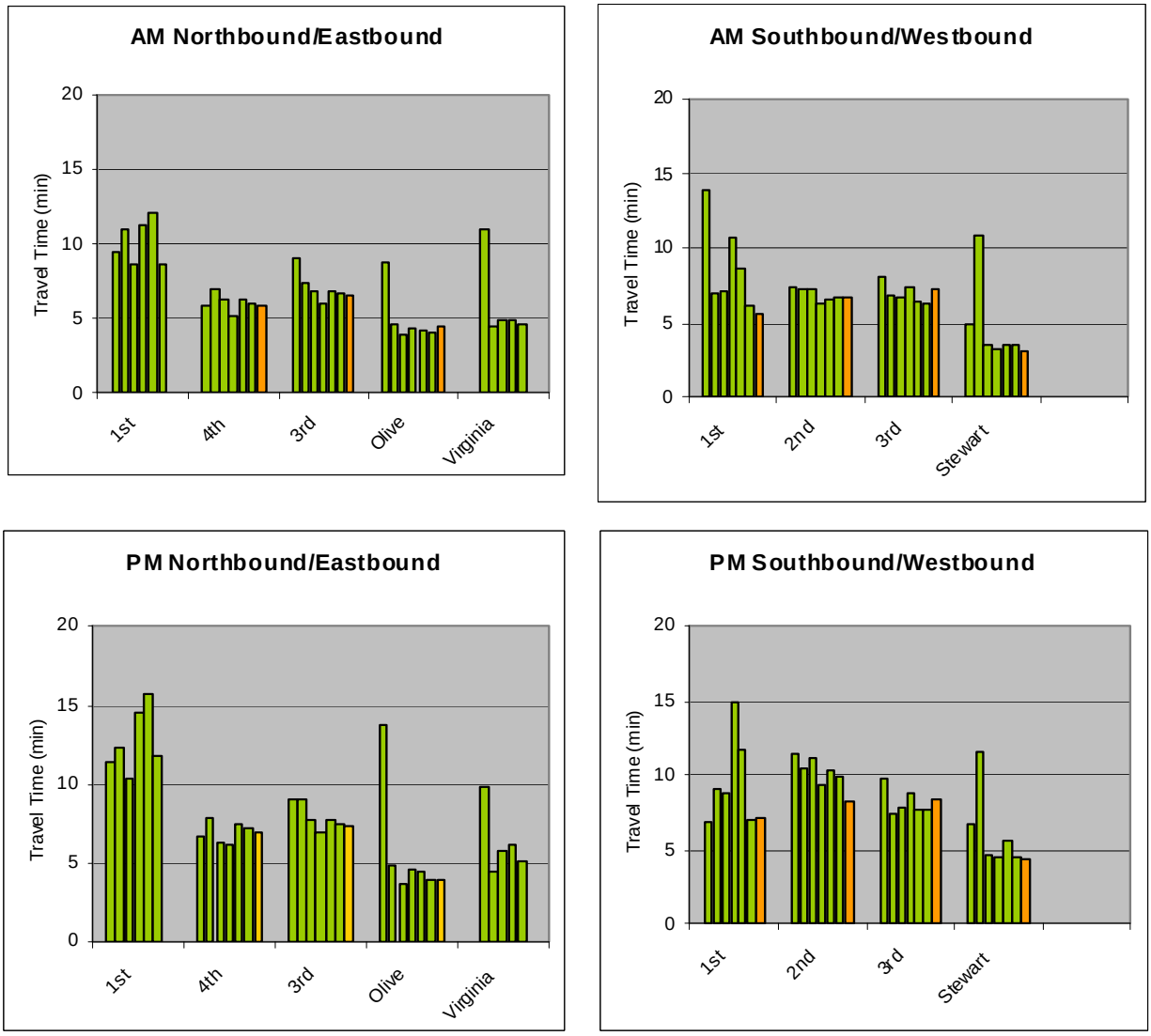
The average corridor travel times in this report are compared to the comparable statistics for both pre-tunnel closure baseline conditions and for the tunnel closure data reported in successive reports. Corridor travel times should not be compared to each other. Readers were placed to ensure route coverage. Readers were also sited to facilitate communications and insure access to power. As a result, the measured corridors differ in length, number of stops and number of signals, all of which affect travel time but are not related to congestion.

The reader locations that define the boundaries of each of the transit corridors are described below along with a table for each corridor that summarizes the Average Travel Time by time period along with the standard deviation (SD) of the observations in minutes. As a statistical measure, approximately 69% of all observations are within one standard deviation of the average. The SD can be interpreted as approximating the range (+/- 1SD) of the typical travel time that a majority of bus riders will experience on the corridor. There are seven data points; Volume 1 pre-tunnel baseline, and Volume 2 through 6 post-tunnel closure observations, and Volume 7 tunnel re-opening.

- Volume 1: Pre-Tunnel Closure Baseline, Data from Summer, 2005
- Volume 2: Post Tunnel Closure, Data from Fall 2005
- Volume 3: Post Tunnel Closure, Data from Spring 2006
- Volume 4: Post Tunnel Closure, Data from Summer 2006
- Volume 5: Post Tunnel Closure, Data from Fall 2006
- Volume 6: Post Tunnel Closure, Data from Spring, 2007
- Volume 7: Tunnel Re-Opening, Data from Fall, 2007

Travel time summaries for all seven data sets are provided in Figure 5 and Figures 6 A through F.

Figure 5. Transit Corridor Travel Time Comparisons Before and After Tunnel Closure



Notes: No data available for northbound First Avenue for Volume 7 tunnel re-opening report.
No data available for Virginia Street for Volume 7 as routing path that was previously measured was eliminated when tunnel re-opened.

Figure 6A. First Avenue Transit Travel Time and Variation

First Avenue	AM Peak (7 – 9 AM)	PM Peak (4 – 6 PM)
Northbound, Royal Brougham to Seneca Street	Travel time: Baseline – 9 min 22 sec *(SD: 4.8 min)* Volume 2 – 10 min 54 sec *(SD: 5.8 min)* Volume 3 – 8 min 36 sec *(SD:1.8 min)* Volume 4 – 11 min 8 sec *(SD:2.1 min)* Volume 5 – 12 min 6 sec *(SD:2 min)* Volume 6 – 8 min 33 sec *(SD:1.2 min)* Volume 7 – not available *Change from Volume 6: n/a*	Travel Time: Baseline – 11 min 24 sec *(SD: 5.3 min)* Volume 2 – 12 min 12 sec *(SD:6.0 min)* Volume 3 – 10 min 18 sec *(SD:3 min)* Volume 4 – 14 min 34 sec *(SD:4.3 min)* Volume 5 – 15 min 41 sec *(SD:4 min)* Volume 6 – 11 min 47 sec *(SD:3.2 min)* Volume 7 – not available *Change from Volume 6: n/a*
Southbound, Seneca Street to Royal Brougham*	Travel time: Baseline – 14 min *(SD: 8.8 min)* Volume 2 – 7 min *(SD: 5.4 min)* Volume 3 – 7 min 8 sec *(SD:1 min)* Volume 4 – 10 min 40 sec *(SD:1.8 min)* Volume 5 – 8 min 39 sec *(SD:1.5 min)* Volume 6 – 6 min 9 sec *(SD:1 min)* Volume 7 – 5 min 37 sec *(SD:1.2 min)* *Change from Volume 6: -32 sec*	Travel time: Baseline – 6 min 51 sec *(SD: 3.9 min)* Volume 2 – 9 min 6 sec *(SD: 6 min)* Volume 3 – 8 min 49 sec *(SD:1.4 min)* Volume 4 – 14 min 55 sec *(SD:3 min)* Volume 5 – 11 min 42 sec *(SD:3.1 min)* Volume 6 – 7 min 1 sec *(SD:2.4 min)* Volume 7 – 7 min 15 sec *(SD:1.6 min)* *Change from Volume 6: +14 sec*

First Avenue (Northbound and Southbound) reader locations are Royal Brougham to the south and Stewart Street to the north, with a midpoint at Seneca Street. Average travel time and variation in travel time on First Avenue was effectively unchanged in the southbound direction. No northbound data is available for this period due to communications interference within the readers.

Figure 6B. Second Avenue Transit Travel Time and Variation

Second Avenue	AM Peak (7 – 9 AM)	PM Peak (4 – 6 PM)
Southbound, Pike Street to S Jackson Street	Travel time: Baseline – 7 min 20 sec *(SD: 1.9 min)* Volume 2 – 7 min 13 sec *(SD: 2.6 min)* Volume 3 – 7 min 11 sec *(SD:1.45 min)* Volume 4 – 6 min 13 sec *(SD:1.5 min)* Volume 5 – 6 min 35 sec *(SD:1.4 min)* Volume 6 – 6 min 47 sec *(SD:1.4 min)* Volume 7 – 6 min 41 sec *(SD:1.4 min)* *Change from Volume 6: -6 sec*	Travel time: Baseline – 11 min 26 sec *(SD: 4.3 min)* Volume 2 – 10 min 26 sec *(SD: 3.5 min)* Volume 3 – 11 min 10 sec *(SD:2.4 min)* Volume 4 – 9 min 22 sec *(SD:2.2 min)* Volume 5 – 10 min 18 sec *(SD:2.5 min)* Volume 6 – 9 min 55 sec *(SD:2.0 min)* Volume 7 – 8 min 16 sec *(SD:1.8 min)* *Change from Volume 6: -1m 39sec*

Second Avenue (Southbound only) reader locations are Pike Street and S Jackson Street with a midpoint at Seneca Street. Because this measurement is for the entire length of Second Avenue, it does not capture the sometimes significant delays for transit turning right at Columbia Street to access SR99 southbound. Second Avenue travel time remained the same in the AM with no change in variation, and improved by over 90 seconds in the PM with a small decrease in variation. PM Peak improvements are due primarily to the reopening of the bus tunnel, with some routes moving to the tunnel or Third Avenue.

Figure 6C. Third Avenue Transit Travel Time and Variation

Third Avenue	**AM Peak (7 – 9 AM)**	**PM Peak (4 – 6 PM)**
Northbound, Yesler Way to Stewart Street	Travel time: Baseline – 9 min *(SD: 4.6 min)* Volume 2 – 7 min 20 sec *(SD: 3.1 min)* Volume 3 – 6 min 53 sec *(SD:1.3 min)* Volume 4 – 5 min 53 sec *(SD:1.3 min)* Volume 5 – 6 min 43 sec *(SD:1.3 min)* Volume 6 – 6 min 37 sec *(SD:1.2 min)* Volume 7 – 6 min 30 sec *(SD:1.4 min)* *Change from Volume 6: -7 sec*	Travel Time: Baseline – 9 min 6 sec *(SD: n/a)* Volume 2 – 8 min 57 sec *(SD: 3.6 min)* Volume 3 – 7 min 41 sec *(SD:1.3 min)* Volume 4 – 6 min 53 sec *(SD:1.8 min)* Volume 5 – 7 min 47 sec *(SD:1.9 min)* Volume 6 – 7 min 26 sec *(SD:1.6 min)* Volume 7 – 7 min 17 sec *(SD:2.2 min)* *Change from Volume 6: -9 sec*
Southbound, Stewart Street to Yesler Way	Travel time: Baseline – 8 min 5 sec *(SD: 1.3 min)* Volume 2 – 6 min 52 sec *(SD: 2.8 min)* Volume 3 – 6 min 36 sec *(SD:1.6 min)* Volume 4 – 7 min 17 sec *(SD:1.5 min)* Volume 5 – 6 min 26 sec *(SD:1.4 min)* Volume 6 – 6 min 20 sec *(SD:1.5 min)* Volume 7 – 7 min 12 sec *(SD:1.5 min)* *Change from Volume 6: +52 sec*	Travel time: Baseline – 9 min 45 sec *(SD: 2.5 min)* Volume 2 – 7 min 27 sec *(SD: 2.9 min)* Volume 3 – 7 min 51 sec *(SD:1.5 min)* Volume 4 – 8 min 46 sec *(SD:1.8 min)* Volume 5 – 7 min 46 sec *(SD:1.6 min)* Volume 6 – 7 min 43 sec *(SD:1.6 min)* Volume 7 – 8 min 21 sec *(SD:1.5 min)* *Change from Volume 6: +38 sec*

Third Avenue (Northbound and Southbound) reader locations are Stewart Street to the north and Yesler Way to the south, with a midpoint at Seneca Street. Average travel times in the northbound direction are essentially unchanged from the previous period, with increased variation in the PM peak. Southbound average travel times increased in both peak periods, with variation remaining consistent. Some of the increase in the southbound travel times is due to an increase in the number of routes on the corridor. Travel times in both directions and peak periods are continue to be 1 minute faster or more than the pre-closure conditions.

Figure 6D. Fourth Avenue Transit Travel Time and Variation

Fourth Avenue	**AM Peak (7 – 9 AM)**	**PM Peak (4 – 6 PM)**
Northbound, S Jackson Street to Seneca Street	Travel time: Baseline – 5 min 48 sec *(SD: 1.2 min)* Volume 2 – 6 min 58 sec *(SD: 2.8 min)* Volume 3 – 6 min 14 sec *(SD:1.35 min)* Volume 4 – 5 min 12 sec *(SD:1.2 min)* Volume 5 – 6 min 16 sec *(SD:1.3 min)* Volume 6 – 5 min 59 sec *(SD:1.1 min)* Volume 7 – 5 min 50 sec *(SD:1.2 min)* *Change from Volume 6: -9 sec*	Travel Time: Baseline – 6 min 46 sec *(SD: 1.1 min)* Volume 2 – 7 min 50 sec *(SD: 4 min)* Volume 3 – 6 min 15 sec *(SD:2 min)* Volume 4 – 6 min 11 sec *(SD:2.2 min)* Volume 5 – 7 min 29 sec *(SD:2.8 min)* Volume 6 – 7 min 9 sec *(SD:2.1 min)* Volume 7 – 6 min 54 sec *(SD:2.0 min)* *Change from Volume 6: -15 sec*

Fourth Avenue (Northbound only) reader locations are Seneca Street to the north and S Jackson Street to the south. Average travel times and variation were essentially unchanged from the previous report.

Figure 6E. Virginia, Olive Way and Howell Transit Travel Time and Variation

	AM Peak (7 – 9 AM)	PM Peak (4 – 6 PM)
Eastbound Virginia Street, Third Avenue to Ninth Avenue	Travel time: Baseline – *n/a* Volume 2 – 10 min 39 sec *(SD: 5.1 min)* Volume 3 – 4 min 23 sec *(SD : .9 min)* Volume 4 – 4 min 53 sec *(SD .9 min)* Volume 5 – 4 min 53 sec *(SD:1.0 min)* Volume 6 – 4 min 35 sec *(SD:1.0 min)* Volume 7 – n/a *Change from Volume 6: n/a*	Travel Time: Baseline – *n/a* Volume 2 – 9 min 50 sec *(SD: 4.9 min)* Volume 3 – 4 min 28 sec *(SD:1 min)* Volume 4 – 5 min 48 sec *(SD:2.4 min)* Volume 5 – 6 min 11 sec *(SD:2.7 min)* Volume 6 – 5 min 3 sec *(SD:2.0 min)* Volume 7 – n/a *Change from Volume 6: n/a*
Eastbound Olive Way, Third Avenue to Eighth Avenue	Travel time: Baseline – 8 min 42 sec *(SD: 9.1 min)* Volume 2 – 4 min 34 sec *(SD: 2.4 min)* Volume 3– 3 min 54 sec *(SD : 1 min)* Volume 4 – 4 min 19 sec *(SD:1 min)* Volume 5 – 4 min 6 sec *(SD:1.1 min)* Volume 6 – 4 min 5 sec *(SD:1.3 min)* Volume 7 – 4 min 25 sec *(SD:1.4 min)* *Change from Volume 6: +20sec*	Travel Time: Baseline – 13 min 43 sec *(SD: 9.7 min)* Volume 2 – 4 min 51 sec *(SD: 2.5 min)* Volume 3 – 3 min 41 sec *(SD : .9 min)* Volume 4 – 4 min 34 sec *(SD: 1.45 min)* Volume 5 – 4 min 25 sec *(SD:1.9 min)* Volume 6 – 3 min 57 sec *(SD:1.8 min)* Volume 7 – 3 min 56 sec *(SD:1.5 min)* *Change from Volume 6: -1 sec*
Eastbound Howell Street, Eighth Ave to Yale Street	Travel time: Baseline – 2 min 6 sec *(SD: 1.4 min)* Volume 2 – 3 min 53 sec *(SD: 2.4 min)* Volume 3 – 3 min 23 sec *(SD :1.6 min)* Volume 4 – 3 min 3 sec *(SD: 1.25 min)* Volume 5 – 3 min 3 sec *(SD:1.3 min)* Volume 6 – 3 min 19 sec *(SD:1.3 min)* Volume 7 – 3 min 10 sec *(SD:1.1 min)* *Change from Volume 6: -9 sec*	Travel Time: Baseline – 5 min 25 sec *(SD: 3.1 min)* Volume 2 – 5 min 37 sec *(SD: 3.3 min)* Volume 3 – 4 min 50 sec *(SD:2.3 min)* Volume 4 – 5 min 23 sec *(SD:2.5 min)* Volume 5 – 5 min 51 sec *(SD:2.6 min)* Volume 6 – 5 min 21 sec *(SD:2.9 min)* Volume 7 – 5 min 56 sec *(SD:2.2 min)* *Change from Volume 6: +35 sec*

Virginia Street (Eastbound only) reader locations are Third Avenue at Stewart Street to the west and Ninth Avenue at Stewart Street to the east. There was no transit service on Virginia Street before the tunnel closure, so there is no baseline data. With the reopening of the Transit Tunnel, there is no longer transit service following the routing used during tunnel closure, so there is no data to report.

Olive Way (Eastbound only) reader locations are Third Avenue to the west and Eighth Avenue to the east. Average travel times were 20 seconds longer in the AM peak from the previous report, with little change in variation. Average travel time in the PM peak was the same as the previous period with an improvement in variation.

Howell Street (Eastbound only): Transit on Howell Street east of Eighth Avenue was slightly faster in the AM peak and 30 seconds slower in the PM peak as compared to the previous reporting period with slight improvements in variation in both peak periods. PM Peak average travel times matched observations from the same period in 2006.

Figure 6F. Stewart Street Transit Travel Time and Variation

	AM Peak (7 – 9 AM)	PM Peak (4 – 6 PM)
Westbound, Ninth Avenue to Third Avenue	Travel time: Baseline – 4 min 50 sec *(SD: 1.9 min)* Volume 2 – 10 min 52 sec *(SD: 5.2 min)* Volume 3 – 3 min 31 sec *(SD:1 min)* Volume 4 – 3 min 8 sec *(SD: 1.5 min)* Volume 5 – 3 min 32 sec *(SD:1.05 min)* Volume 6 – 3 min 27 sec *(SD:0.9 min)* Volume 7 – 3 min 3 sec *(SD:0.8 min)* *Change from Volume 6: -24 sec*	Travel Time: Baseline – 6 min 42 sec *(SD: 1.5 min)* Volume 2 – 11 min 36 sec *(SD: 4.9 min)* Volume 3 – 4 min 42 sec *(SD: 2 min)* Volume 4 – 4 min 32 sec *(SD: 2.5 min)* Volume 5 – 5 min 40 sec *(SD:3.3 min)* Volume 6 – 4 min 34 sec *(SD:2.2 min)* Volume 7 – 4 min 23 sec *(SD:2.9 min)* *Change from Volume 6: -11 sec*

Stewart Street (Westbound only) reader locations are Third Avenue to the west and Ninth Avenue to the east. Average travel time improved slightly in both the peak periods. Variation in the PM Peak increased by about 30%.

Summary Conclusions

Based on the trends in the travel time indexes and the corridor specific travel time data, the following conclusions can be made:

- Transit improvements reduced surface travel times by roughly one fourth, while accommodating more than 100 additional trips displaced from the tunnel per hour.
- Third Avenue peak period restrictions improved transit travel time on that corridor by one to two minutes depending on time of day, while accommodating almost 100 additional trips per hour
- A seasonal trend appears to exist where fall travel times are slower than spring and summer travel times.
- Maintaining the transit improvements with the return of transit service volumes to the tunnel appears to have offset most of the fall seasonal increase in travel time, while improving Second Avenue travel times by more than one and a half minutes in the critical PM Peak.